U.S. DEPARTMENT OF COMMERCE
National Technical Information Service

PB-264 579

Lake Albert, Kingsbury County, South Dakota

National Eutrophication Survey, Corvallis, Oreg

Prepared for

Corvallis Environmental Research Lab, Oreg

Jan 77

PB 264 579

U.S. ENVIRONMENTAL PROTECTION AGENCY
NATIONAL EUTROPHICATION SURVEY

WORKING PAPER SERIES

CORVALLIS ENVIRONMENTAL RESEARCH LABORATORY - CORVALLIS, OREGON

and

ENVIRONMENTAL MONITORING & SUPPORT LABORATORY - LAS VEGAS, NEVADA

REPRODUCED BY
NATIONAL TECHNICAL
INFORMATION SERVICE
U.S. DEPARTMENT OF COMMERCE
SPRINGFIELD, VA. 22161

.O. 699-440

REPORT
ON
LAKE ALBERT
KINGSBURY COUNTY
SOUTH DAKOTA
EPA REGION VIII
WORKING PAPER No. 598

WITH THE COOPERATION OF THE
SOUTH DAKOTA DEPARTMENT OF ENVIRONMENTAL PROTECTION
AND THE
SOUTH DAKOTA NATIONAL GUARD
JANUARY, 1977

TECHNICAL REPORT DATA
(Please read Instructions on the reverse before completing)

1. REPORT NO.	2.	3. RECIPIENT'S ACCESSION NO.
4. TITLE AND SUBTITLE Report on Lake Albert, Kingsbury County, South Dakota		5. REPORT DATE Prepared January 1977 6. PERFORMING ORGANIZATION CODE
7. AUTHOR(S) Anonymous (National Eutrophication Survey Staff)		8. PERFORMING ORGANIZATION REPORT NO. Working Paper # 598
9. PERFORMING ORGANIZATION NAME AND ADDRESS National Eutrophication Survey U.S. Environmental Protection Agency 200 S. W. 35th St. Corvallis, Oregon 97330		10. PROGRAM ELEMENT NO. 11. CONTRACT/GRANT NO.
12. SPONSORING AGENCY NAME AND ADDRESS Office of Research and Development U.S. Environmental Protection Agency 401 M Street, S. W. Washington, DC 20460		13. TYPE OF REPORT AND PERIOD COVERED Final - 1974 14. SPONSORING AGENCY CODE

15. SUPPLEMENTARY NOTES
Prepared in cooperation with the U.S. Environmental Protection Agency, National Environmental Research Center, Las Vegas, Nevada 89114

16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

17. KEY WORDS AND DOCUMENT ANALYSIS

a. DESCRIPTORS	b. IDENTIFIERS/OPEN-ENDED TERMS	c. COSATI Field/Group
eutrophication lakes nutrients phosphorus nitrogen loading		05B 05C

18. DISTRIBUTION STATEMENT	19. SECURITY CLASS (This Report)	21. NO. OF PAGES
Release unlimited		32
	20. SECURITY CLASS (This page)	22. PRICE
		PC A03

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FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to freshwater lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's freshwater lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the South Dakota Departments of Environmental Protection and Game, Fish and Parks for professional involvement, to the South Dakota National Guard for conducting the tributary sampling phase of the Survey, and to those wastewater treatment plant operators who voluntarily provided effluent samples.

Allyn Lockner, Secretary, and Blaine Barker and Duane Murphy, Department of Environmental Quality; Douglas Hansen, Department of Game, Fish and Parks; and James Hayden, Director, State Lakes Preservation Committee provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

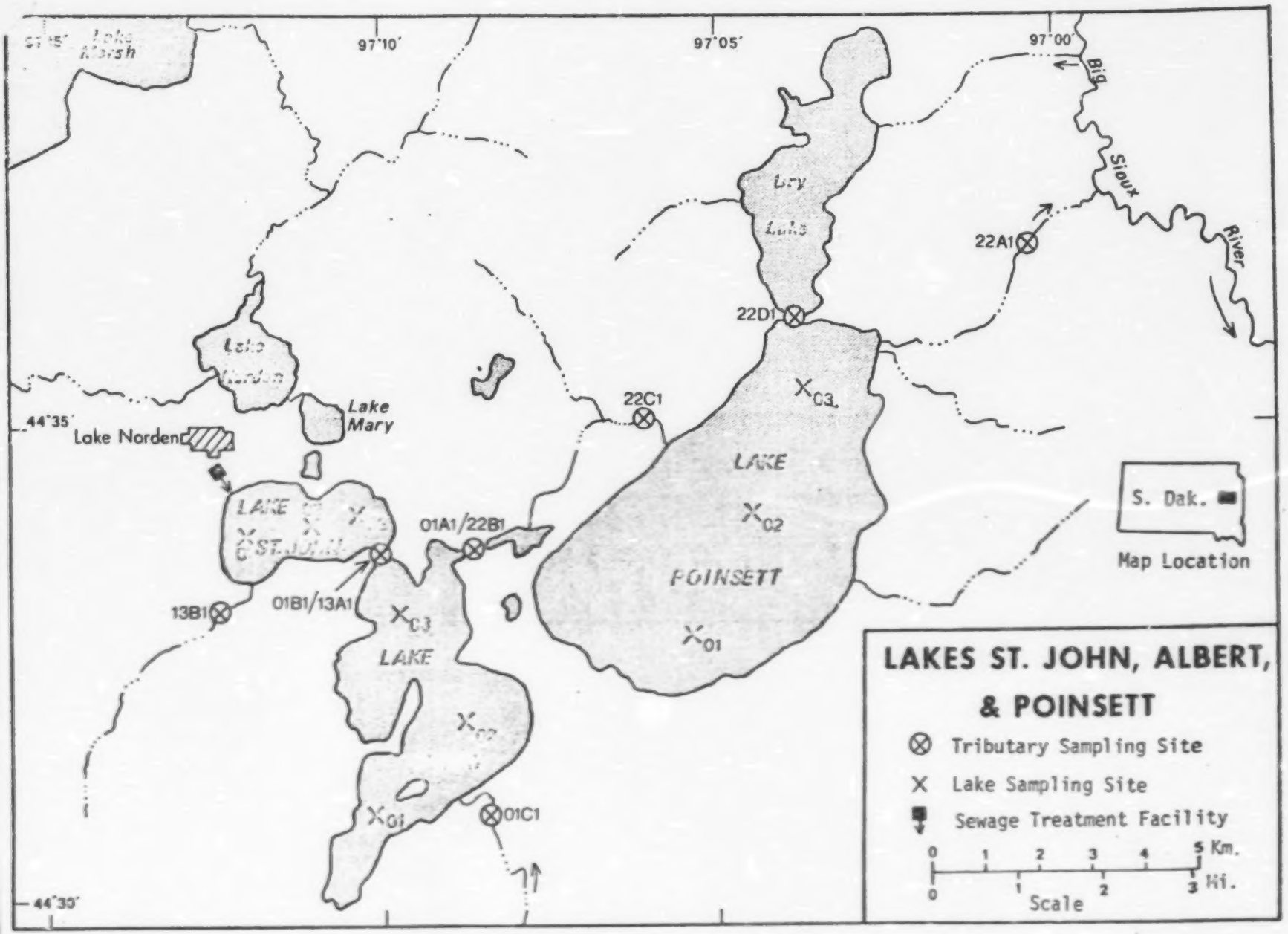
Major General Duane L. Corning, the Adjutant General of South Dakota, and Project Officer Colonel Robert D. Chalberg, who directed the volunteer efforts of the South Dakota National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF SOUTH DAKOTA

LAKE NAME	COUNTY
Albert	Kingsbury
Alvin	Lincoln
Angostura	Fall River
Brant	Lake
Byron	Beadle
Clear	Marshall
Clear	Minnehaha
Cochrane	Deuel
Cottonwood	Spink
Deerfield	Pennington
Enemy Swim	Day
Herman	Lake
John	Hamlin
Kampeska	Codington
Madison	Lake
Mitchell	Davidson
Norden	Hamlin
East Oakwood	Brookings
West Oakwood	Brookings
Pactola	Pennington
Pickerel	Day
Poinsett	Brookings, Lake
Red Iron South	Marshall
Richmond	Brown
Roy	Marshall
Sand	Brown
Sheridan	Pennington
Stockdale	Custer
East Vermillion	McCook
Wall	Minnehaha
Waubay	Day


97°15'
97°10'
97°05'
97°00'
44°35'
44°30'
Lake Marsh
Big Sioux River
Lake Norden
Lake Mary
LAKE ST. JOHN
LAKE
POINSETT
01A1/22B1
01B1/13A1
13B1
22A1
22C1
22D1
01C1
S. Dak.
Map Location
LAKES ST. JOHN, ALBERT, & POINSETT
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
0 1 2 3 4 5 Km.
0 1 2 3 Mi.
Scale

LAKE ALBERT

STORET NO. 4601

I. INTRODUCTION

Due to low daily flows, only a few tributary samples were collected at Lake Albert, and this report relates to only the lake sampling data. The few tributary data obtained are included in Appendix E for the record.

II. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Lake Albert is eutrophic. It ranked twenty-sixth in overall trophic quality when the 31 South Dakota lakes were compared using a combination of six water quality parameters*. Twenty-four lakes had less median total phosphorus, 12 had less median dissolved orthophosphorus, 24 had less median inorganic nitrogen, 23 had less mean chlorophyll a, and 27 had greater mean Secchi disc transparency.

Survey limnologists noted very dense algal blooms at all stations during the July and September sampling visits.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Lake Albert was limited by nitrogen at the times the samples were collected (April and September). The lake data indicate nitrogen limitation at all sampling stations and times.

* See Appendix A.

III. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 14.16 kilometers^2.
2. Mean depth: 1.2 meters.
3. Maximum depth: 3.0 meters.
4. Volume: 16.992 x 10^6 m^3.
5. Mean hydraulic retention time: 8.4 years (based on outflow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Unnamed Creek B-1	450.7	0.059
Unnamed Creek C-1	41.4	0.009
Minor tributaries & immediate drainage -	50.5	0.028
Totals	542.6	0.096

2. Outlet -

Unnamed Creek A-1	556.8**	0.064

C. Precipitation***:

1. Year of sampling: 38.5 centimeters.
2. Mean annual: 60.0 centimeters.

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† Table of metric conversions--Appendix B.
†† Murphey, 1974.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

IV. LAKE WATER QUALITY SUMMARY

Lake Albert was sampled three times during the open-water season of 1974 by means of a pontoon-equipped Huey helicopter. Each time, samples for physical and chemical parameters were collected from one or more depths at three stations on the lake (see map, page v). During each visit, a single depth-integrated (near bottom to surface) sample was composited from the stations for phytoplankton identification and enumeration; and during the first and last visits, a single 18.9-liter depth-integrated sample was composited for algal assays. Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depth sampled at all stations was 0.6 meters.

The sampling results are presented in full in Appendix D and are summarized in the following table.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR LAKE ALBERT
STORET CODE 4601

PARAMETER	1ST SAMPLING (4/23/74) 3 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/12/74) 3 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (9/20/74) 3 SITES RANGE	MEAN	MEDIAN
TEMP (C)	8.6 - 9.0	8.8	8.7	24.2 - 24.5	24.4	24.4	16.3 - 16.6	16.4	16.4
DISS OXY (MG/L)	9.8 - 10.6	10.1	10.0	5.8 - 7.8	6.8	6.6	8.6 - 9.5	9.2	9.4
CNDCTVY (MC-OMO)	621. - 623.	622.	621.	1352. - 1374.	1365.	1369.	1283. - 1296.	1291.	1294.
PH (STAND UNITS)	8.4 - 8.6	8.5	8.5	8.9 - 9.1	9.0	9.0	8.4 - 8.5	8.5	8.5
TOT ALK (MG/L)	182. - 187.	184.	184.	187. - 248.	224.	235.	256. - 296.	275.	276.
TOT P (MG/L)	0.269 - 0.321	0.299	0.307	0.343 - 0.465	0.383	0.363	0.251 - 0.329	0.288	0.287
ORTHO P (MG/L)	0.012 - 0.018	0.015	0.015	0.095 - 0.173	0.126	0.123	0.015 - 0.019	0.018	0.018
NO2+NO3 (MG/L)	0.050 - 0.120	0.080	0.070	0.090 - 0.110	0.100	0.100	0.020 - 0.020	0.020	0.020
AMMONIA (MG/L)	0.070 - 0.150	0.107	0.100	0.090 - 0.120	0.103	0.105	0.030 - 0.040	0.038	0.040
KJEL N (MG/L)	2.400 - 2.800	2.600	2.600	3.700 - 4.500	4.067	4.000	4.400 - 4.800	4.533	4.450
INORG N (MG/L)	0.120 - 0.270	0.187	0.170	0.180 - 0.220	0.203	0.205	0.050 - 0.060	0.058	0.060
TOTAL N (MG/L)	2.520 - 2.856	2.680	2.670	3.810 - 4.600	4.167	4.100	4.420 - 4.820	4.553	4.470
CHLRPYL A (UG/L)	48.1 - 76.1	61.1	58.9	139.8 - 267.3	185.7	150.1	34.8 - 98.6	72.1	82.9
SECCHI (METERS)	0.2 - 0.3	0.2	0.2	0.3 - 0.3	0.3	0.3	0.3 - 0.3	0.3	0.3

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/23/74	1. Cyclotella sp.	166,067
	2. Dactylococcopsis sp.	7,374
	3. Chroomonas sp.	2,978
	4. Melosira sp.	2,269
	5. Oscillatoria sp.	1,702
	Other genera	5,106
	Total	185,496
07/12/74	1. Aphanizomenon sp.	16,351
	2. Melosira sp.	2,633
	3. Stephanodiscus sp.	1,019
	4. Oscillatoria sp.	1,571
	5. Oocystis sp.	977
	Other genera	2,549
	Total	25,100
09/20/74	1. Aphanizomenon sp.	26,711
	2. Melosira sp.	12,197
	3. Oocystis sp.	1,708
	4. Scenedesmus sp.	732
	5. Stephanodiscus sp.	610
	Other genera	3,901
	Total	45,859

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/23/74	1	48.1
	2	76.1
	3	58.9
07/12/74	1	139.8
	2	150.1
	3	267.3
09/20/74	1	98.6
	2	34.8
	3	82.9

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. April sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.065	0.292	11.3
0.050 P	0.115	0.292	12.5
0.050 P + 1.0 N	0.115	1.292	33.4
1.0 N	0.065	1.292	35.2

b. September sample -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.110	0.464	13.1
0.050 P	0.160	0.464	13.2
0.050 P + 1.0 N	0.160	1.464	36.6
1.0 N	0.110	1.464	28.7

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Albert Lake was high at the time the samples were collected (04/23/74 and 09/20/74). Also, in both samples the lack of growth response with the addition of phosphorus alone, until nitrogen was also added, indicates that the lake was limited by nitrogen at those times. Note that the addition of nitrogen alone resulted in a yield significantly greater than that of the control.

The lake data indicate nitrogen limitation at all sampling times; i.e., the mean inorganic nitrogen/orthophosphorus ratios were 12/1 or less at all sampling stations and times, and nitrogen limitation would be expected.

V. LITERATURE REVIEWED

Murphey, Duane G., 1974. Personal communication (waterbody information and morphometry). SD Dept. of Env. Prot., Pierre.

Petrie, Lester R., and L. Rodney Larson, 1966(?). Quality of water in selected lakes of eastern South Dakota. Rept. of Inv. #1, SD Water Res. Comm., Pierre.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKE DATA TO BE USED IN RANKINGS

LAKE COD	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
4601	LAKE ALBERT	0.321	0.170	489.111	106.289	9.200	0.019
4602	ALVIN LAKE	0.067	0.970	442.833	4.700	9.400	0.017
4603	ANGOSTURA RESERVOIR	0.019	0.160	423.333	3.717	13.000	0.005
4604	BRANT LAKE	0.194	0.130	432.833	34.150	11.800	0.113
4605	LAKE BYRON	0.443	0.370	488.333	149.350	9.000	0.146
4606	CLEAR LAKE	0.027	0.075	430.167	11.983	8.800	0.009
4607	CLEAR LAKE	1.400	0.270	495.333	691.000	7.000	0.468
4608	COCHRANE LAKE	0.037	0.150	446.000	15.683	15.000	0.008
4609	COTTONWOOD LAKE	0.685	0.265	490.333	112.017	8.600	0.417
4610	DEERFIELD RESERVOIR	0.033	0.080	303.333	3.650	15.000	0.022
4611	ENEMY SWIM LAKE	0.037	0.085	442.600	14.200	8.200	0.013
4612	LAKE HERMAN	0.340	0.155	485.000	58.733	8.600	0.174
4613	ST JOHN LAKE	0.344	0.080	489.400	120.880	9.800	0.025
4614	LAKE KAMPESKA	0.220	0.105	468.889	20.567	8.200	0.128
4615	MADISON LAKE	0.259	0.090	445.555	22.578	14.000	0.107
4616	LAKE MITCHELL	0.099	0.085	465.833	14.883	13.800	0.015
4617	LAKE NORDEN	0.256	0.165	488.667	46.800	10.000	0.050
4618	OAKWOOD LAKE EAST	0.146	0.175	487.000	113.600	10.000	0.009
4619	OAKWOOD LAKE WEST	0.181	0.135	485.833	159.667	9.600	0.021
4620	PACTOLA RESERVOIR	0.011	0.070	248.444	1.478	11.000	0.006
4621	PICKEREL LAKE	0.049	0.095	439.833	15.833	9.600	0.009
4622	LAKE POINSETT	0.115	0.315	468.444	40.211	10.000	0.023
4623	LAKE RED IRON SOUTH	0.042	0.110	430.333	6.883	7.600	0.010
4624	RICHMOND LAKE	0.187	0.150	410.000	18.467	10.000	0.144
4625	ROY LAKE	0.034	0.070	431.000	13.333	11.000	0.010
4626	SAND LAKE	0.489	0.110	471.800	65.790	12.800	0.288
4627	SHERIDAN LAKE	0.053	0.105	394.000	15.433	15.000	0.016
4628	STOCKADE LAKE	0.233	0.150	432.000	25.400	15.000	0.109

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
4629	LAKE VERMILLION	0.211	0.100	472.833	100.800	9.200	0.092
4630	WALL LAKE	0.194	0.160	441.667	55.267	7.400	0.076
4631	WAUBAY LAKE NORTH	0.098	0.145	469.555	127.033	11.400	0.023

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
4601	LAKE ALBERT	20 (6)	20 (6)	10 (3)	23 (7)	68 (20)	60 (18)	201
4602	ALVIN LAKE	67 (20)	0 (0)	57 (17)	90 (27)	63 (19)	63 (19)	340
4603	ANGOSTURA RESERVOIR	97 (29)	30 (9)	87 (26)	93 (28)	20 (6)	100 (30)	427
4604	BRANT LAKE	40 (12)	53 (16)	70 (21)	47 (14)	27 (8)	23 (7)	260
4605	LAKE BYRON	10 (3)	3 (1)	17 (5)	7 (2)	73 (22)	13 (4)	123
4606	CLEAR LAKE	93 (28)	93 (28)	83 (25)	83 (25)	77 (23)	90 (27)	519
4607	CLEAR LAKE	0 (0)	10 (3)	0 (0)	0 (0)	100 (30)	0 (0)	110
4608	COCHRANE LAKE	83 (25)	40 (11)	50 (15)	67 (20)	5 (0)	93 (28)	338
4609	COTTONWOOD LAKE	3 (1)	13 (4)	3 (1)	20 (6)	82 (24)	3 (1)	124
4610	DEERFIELD RESERVOIR	90 (27)	88 (26)	97 (29)	97 (29)	5 (0)	53 (16)	430
4611	ENEMY SWIM LAKE	80 (24)	82 (24)	60 (18)	77 (23)	88 (26)	73 (22)	460
4612	LAKE HERMAN	17 (5)	33 (10)	27 (8)	33 (10)	82 (24)	10 (3)	202
4613	ST JOHN LAKE	13 (4)	88 (26)	7 (2)	13 (4)	53 (16)	43 (13)	217
4614	LAKE KAMPESKA	33 (10)	65 (19)	40 (12)	57 (17)	88 (26)	20 (6)	303
4615	MADISON LAKE	27 (8)	77 (23)	53 (16)	53 (16)	13 (4)	30 (9)	253
4616	LAKE MITCHELL	60 (18)	82 (24)	47 (14)	73 (22)	17 (5)	70 (21)	349
4617	LAKE NORDEN	23 (7)	23 (7)	13 (4)	40 (12)	45 (12)	40 (12)	184
4618	OAKWOOD LAKE EAST	53 (16)	17 (5)	20 (6)	17 (5)	45 (12)	85 (25)	237
4619	OAKWOOD LAKE WEST	50 (15)	50 (15)	23 (7)	3 (1)	58 (17)	57 (17)	241
4620	PACTOLA RESERVOIR	100 (30)	98 (29)	100 (30)	100 (30)	35 (10)	97 (29)	530
4621	PICKEREL LAKE	73 (22)	73 (22)	67 (20)	63 (19)	58 (17)	85 (25)	419
4622	LAKE POINSETT	57 (17)	7 (2)	43 (13)	43 (13)	45 (12)	47 (14)	242
4623	LAKE RED IRON SOUTH	77 (23)	58 (17)	80 (24)	87 (26)	93 (28)	78 (23)	473
4624	RICHMOND LAKE	47 (14)	40 (11)	90 (27)	60 (18)	45 (12)	17 (5)	299
4625	ROY LAKE	87 (26)	98 (29)	77 (23)	80 (24)	35 (10)	78 (23)	455
4626	SAND LAKE	7 (2)	58 (17)	33 (10)	30 (9)	23 (7)	7 (2)	158
4627	SHERIDAN LAKE	70 (21)	65 (19)	93 (28)	70 (21)	5 (0)	67 (20)	370
4628	STOCKADE LAKE	30 (9)	40 (11)	73 (22)	50 (15)	5 (0)	27 (8)	225

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
4629	LAKE VERMILLION	37 (11)	70 (21)	30 (9)	27 (8)	68 (20)	33 (10)	265
4630	WALL LAKE	43 (13)	27 (8)	63 (19)	37 (11)	97 (29)	37 (11)	304
4631	WAUBAY LAKE NORTH	63 (19)	47 (14)	37 (11)	10 (3)	30 (9)	50 (15)	237

12/

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	4620	PACTOLA RESERVOIR	530
2	4606	CLEAR LAKE	519
3	4623	LAKE RED IRON SOUTH	473
4	4611	ENEMY SWIM LAKE	460
5	4625	ROY LAKE	455
6	4610	DEERFIELD RESERVOIR	430
7	4603	ANGOSTURA RESERVOIR	427
8	4621	PICKEREL LAKE	419
9	4627	SHERIDAN LAKE	370
10	4616	LAKE MITCHELL	349
11	4602	ALVIN LAKE	340
12	4608	COCHRANE LAKE	338
13	4630	WALL LAKE	304
14	4614	LAKE KAMPESKA	303
15	4624	RICHMOND LAKE	299
16	4629	LAKE VERMILLION	265
17	4604	BRANT LAKE	260
18	4615	MADISON LAKE	253
19	4622	LAKE POINSETT	242
20	4619	OAKWOOD LAKE WEST	241
21	4631	WAUBAY LAKE NORTH	237
22	4618	OAKWOOD LAKE EAST	237
23	4628	STOCKADE LAKE	225
24	4613	ST JOHN LAKE	217
25	4612	LAKE HERMAN	202
26	4601	LAKE ALBERT	201
27	4617	LAKE NORDEN	184
28	4626	SAND LAKE	158

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
29	4609	COTTONWOOD LAKE	124
30	4605	LAKE BYRON	123
31	4607	CLEAR LAKE	110

APPENDIX B

CONVERSION FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 76/05/03

460101
44 31 00.0 097 10 00.0 4
LAKE ALBE-
46011 SOUTH DAKOTA
090791

11EPALES 2111202
0006 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/23	12 45	0000	8.6	9.8	7	621	8.40	182	0.150	2.400	0.120	0.018
74/07/12	11 00	0000	24.5	6.8	12	1374	9.00	248	0.110	4.500	0.100	0.173
	11 00	0002	24.5	6.4		1374	8.90	236	0.110	3.700	0.110	0.137
74/09/20	14 00	0000	16.4	9.6	12	1294	8.55	256	0.030	4.700	0.020K	0.019
	14 00	0002	16.4	9.8		1294	8.55	272	0.040	4.400	0.020K	0.019

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/23	12 45	0000	0.321	48.1	
74/07/12	11 00	0000	0.343	139.8	
	11 00	0001			1.0
	11 00	0002	0.407		
74/09/20	14 00	0000	0.303	98.6	
	14 00	0002	0.310		1.0

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/05/03

460102
44 33 15.0 097 09 00.0 4
LAKE ALBERT
46011 SOUTH DAKOTA

090791

11EPALES 2111202
0006 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/23	13 00	0000	8.7	10.0	9	621	8.50	187	0.100	2.600	0.070	0.015
74/07/12	10 45	0000	24.2	7.8	12	1369	9.00	234	0.100	4.000	0.100	0.110
	10 45	0002	24.2	5.8		1369	8.90	244	0.120	3.800	0.100	0.102
74/09/20	13 45	0000	16.6	9.6	12	1296	8.50	286	0.040	4.400	0.020K	0.016
	13 45	0002	16.6	9.2		1296	8.50	280	0.040	4.500	0.020K	0.018

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/23	13 00	0000	0.307	75.1	
74/07/12	10 45	0000	0.361	150.1	
	10 45	0001			1.0
	10 45	0002	0.357		
74/09/20	13 45	0000	0.261	34.8	
	13 45	0002	0.329		1.0

81

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 76/05/03

460103
44 36 00.0 097 09 45.0 4
LAKE ALBERT
46057 SOUTH DAKOTA
090791

11EPALES 2111202
0007 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
74/04/23	13	10 0000	9.0	10.6	10	623	8.60	184	0.070	2.800	0.050	0.012
74/07/12	10	30 0000	24.4	7.8	12	1352	9.10	194	0.090	4.400	0.090	0.095
	10	30 0002	24.4	6.0		1352	9.10	187	0.090	4.000	0.100	0.141
74/09/20	13	30 0000	16.3	9.6	12	1283	8.42	260	0.040	4.800	0.020K	0.018
	13	30 0002	16.3	8.6		1283	8.42	296	0.040	4.400	0.020K	0.019

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L	00031 INCDT LT REMNING PERCENT
74/04/23	13	10 0000	0.269	58.9	
74/07/12	10	30 0000	0.365	267.3	
	10	30 0002	0.465		
74/09/20	13	30 0000	0.251	82.9	
	13	30 0002	0.272		1.0

K VALUE KNOWN TO BE
LESS THAN INDICATED

APPENDIX D

TRIBUTARY DATA

STORET RETRIEVAL DATE 76/05/04

460141
44 34 05.0 097 07 40.0 4
UNNAMED CRE
46 7.5 LAKE NORDEN
O/LAKE ALBERT 090791
BRDG ON US 1 5.5 M SE TOWN LAKE NORDEN
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/04/12	15	37		3.150	0.465	0.255	0.340
75/05/17	12	00	0.010	5.000	0.075	0.230	0.320
75/06/19	20	35	0.005	3.450	0.070	0.260	0.380
75/07/12	10	40	0.005	5.500	0.160	0.570	0.840

STORET RETRIEVAL DATE 76/05/04

460181
44 33 30.0 097 10 10.0 4
UNNAMED CRE K
46 7.5 LAKE NORDEN
T/LAKE ALBERT 090791
BRDG ON SEC RD 2.3 MI S OF HWY 28
11EPALES 2111204
0000 FEET DEPTH CLASS 00

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
75/04/12	15 07		3.200	5.500	1.570	1.200	1.350
75/05/17	11 15		0.010	0.500	0.090	0.015	0.070
75/07/12	10 20		0.005	5.400	0.230	0.560	0.820

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TRIBUTARY FLOW INFORMATION FOR SOUTH DAKOTA 05/03/76

LAKE CODE 4601 ALBERT

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 556.8

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
4601A1	556.8	0.0	0.0	0.142	0.283	0.142	0.085	0.057	0.028	0.028	0.0	0.0	0.0	0.064
4601B1	450.7	0.0	0.0	0.142	0.283	0.142	0.057	0.028	0.028	0.028	0.0	0.0	0.0	0.059
4601C1	41.4	0.0	0.0	0.0	0.057	0.028	0.028	0.0	0.0	0.0	0.0	0.0	0.0	0.009
4601ZZ	64.7	0.0	0.0	0.0	0.170	0.057	0.057	0.028	0.014	0.003	0.003	0.0	0.0	0.028

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 556.8
SUM OF SUB-DRAINAGE AREAS = 556.8

TOTAL FLOW IN = 1.15
TOTAL FLOW OUT = 0.76

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4601A1	10	74	0.0	12	0.0				
	11	74	0.0	3	0.0				
	12	74	0.0	8	0.0				
	1	75	0.0	19	0.0				
	2	75	0.0	8	0.0				
	3	75	0.0	1	0.0				
	4	75	0.0	12	0.0				
	5	75	0.0	17	0.0				
	6	75	0.000	19	0.000				
	7	75	0.0	12	0.0				
	8	75	0.0	25	0.0				
	9	75	0.0	6	0.0				
4601B1	10	74	0.0	12	0.0				
	11	74	0.0	3	0.0				
	12	74	0.0	8	0.0				
	1	75	0.0	19	0.0				
	2	75	0.0	8	0.0				
	3	75	0.0	1	0.0				
	4	75	0.006	12	0.003				
	5	75	0.003	17	0.003				
	6	75	0.0	19	0.0				
	7	75	0.0	12	0.0				
	8	75	0.0	17	0.0				
	9	75	0.0	6	0.0				

TRIBUTARY FLOW INFORMATION FOR SOUTH DAKOTA 05/03/76

LAKE CODE 4601 ALBERT

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
4601C1	10	74	0.0	12	0.0				
	11	74	0.0	3	0.0				
	12	74	0.0	8	0.0				
	1	75	0.0	19	0.0				
	2	75	0.0	8	0.0				
	3	75	0.0	1	0.0				
	4	75	0.003	12	0.0				
	5	75	0.003	17	0.0				
	6	75	0.0	19	0.0				
	7	75	0.0	12	0.0				
	8	75	0.0	25	0.0				
	9	75	0.0	6	0.0				
4601ZZ	10	74	0.0						
	11	74	0.0						
	12	74	0.0						
	1	75	0.0						
	2	75	0.0						
	3	75	0.0						
	4	75	0.003						
	5	75	0.003						
	6	75	0.0						
	7	75	0.0						
	8	75	0.0						
	9	75	0.0						